

Claims

- [c1] 1. An optical pellicle comprising:
a transparent plate having a first thickness;
a recessed portion of said transparent plate having a second thickness less than said first thickness; and
a perimeter of said transparent plate having a third thickness and entirely surrounding said recessed portion such that said transparent plate comprises a monolithic optical pellicle.
- [c2] 2. The optical pellicle of claim 1 wherein said transparent plate comprises a material selected from the group consisting of silica, modified silica, quartz and modified fused silica quartz.
- [c3] 3. The optical pellicle of claim 1 wherein said first thickness comprises an original thickness of said transparent plate.
- [c4] 4. The optical pellicle of claim 3 wherein said third thickness of said perimeter of said transparent plate comprises said original thickness.
- [c5] 5. The optical pellicle of claim 1 wherein said third thickness is less than said first thickness.

- [c6] 6. The optical pellicle of claim 1 wherein said transparent plate comprises a material transparent to an exposure radiation ranging from about 157nm wavelengths and lower.
- [c7] 7. The optical pellicle of claim 1 wherein said first thickness of said transparent plate ranges from about 3mm to about 6mm.
- [c8] 8. The optical pellicle of claim 7 wherein said second thickness of said recessed portion ranges from about 200 μ m to about 900 μ m.
- [c9] 9. The optical pellicle of claim 1 wherein said second thickness of said recessed portion is at least thick enough to prevent sagging of said recessed portion due to applied forces on said monolithic optical pellicle.
- [c10] 10. The optical pellicle of claim 1 wherein said monolithic optical pellicle comprises a material of sufficient rigidity for preventing any damage and distortion to said monolithic optical pellicle.
- [c11] 11. The optical pellicle of claim 1 wherein said recessed portion extends into said transparent plate from a single surface thereof and stops at a depth within said transparent plate.

- [c12] 12. The optical pellicle of claim 1 wherein said monolithic optical pellicle comprises a single material having a single thermal expansion.
- [c13] 13. The optical pellicle of claim 1 wherein said perimeter comprises a frame portion and said recessed portion comprises an optical pellicle portion of said monolithic optical pellicle, said frame and optical pellicle portions being a uniform one-piece structure.
- [c14] 14. The optical pellicle of claim 1 wherein said monolithic optical pellicle comprises a first side exposing a substantially planar surface and a second side exposing said recessed portion and said perimeter, wherein at least said recessed portion has an optically flat surface area.
- [c15] 15. The optical pellicle of claim 1 wherein said monolithic optical pellicle has a shape selected from the group consisting of rectangular, square and circular.
- [c16] 16. The optical pellicle of claim 1 further including a plurality of openings traversing through said perimeter of said transparent plate for introducing a gas flow over said recessed portion of said transparent plate upon mounting said monolithic optical pellicle to a photomask.

[c17] 17. The optical pellicle of claim 16 wherein said plurality of openings traversing through said perimeter have shapes selected from the group consisting of circular, oval, rectangular, square and combinations thereof.

[c18] 18. A method of forming an optical pellicle comprising:
providing a pellicle plate of a transparent material having a first thickness; and
removing a portion of said transparent material to transform said pellicle plate into a monolithic optical pellicle comprising a recessed portion of said pellicle plate having a second thickness less than said first thickness that is entirely surrounded and integrally formed with a perimeter frame of said pellicle plate having a third thickness.

[c19] 19. The method of claim 18 wherein said transparent material comprises a material of sufficient rigidity for preventing any stresses and damage to occur in said monolithic optical pellicle.

[c20] 20. The method of claim 18 wherein said transparent material comprises a single material having a single thermal expansion that is transparent to an exposure radiation ranging from about 157nm wavelengths and lower.

- [c21] 21. The method of claim 18 wherein said first thickness comprises an original thickness of said pellicle plate.
- [c22] 22. The method of claim 21 wherein said third thickness of said perimeter frame of said pellicle plate comprises said original thickness.
- [c23] 23. The method of claim 18 further including adjusting for a standoff distance between said monolithic optical pellicle and a photomask to which said monolithic optical pellicle is to be mounted to, said step of adjusting for said standoff distance comprising:
 said perimeter frame of said pellicle plate initially having said first thickness; and
 removing a predetermined thickness from said first thickness of said perimeter frame to provide said perimeter frame with said third thickness, which is less than said first thickness.
- [c24] 24. The method of claim 18 wherein said second thickness of said recessed portion is at least thick enough to prevent sagging of said recessed portion due to applied forces on said monolithic optical pellicle.
- [c25] 25. The method of claim 18 wherein said step of transforming said pellicle plate into said monolithic optical pellicle comprises:

providing said pellicle plate into a processing chamber;

providing a mask on a first side of said pellicle plate to cover only a perimeter area of said pellicle plate, thereby exposing a central portion of said pellicle plate on said first side;

removing said transparent material of said pellicle plate from said exposed central portion on said first side whereby said mask protects said perimeter area of said pellicle plate such that said transparent material at said perimeter area is maintained;

stopping said removal at a predetermined distance within said pellicle plate to integrally form said recessed portion and said perimeter frame on said first side of said pellicle plate; and

removing said mask to provide said monolithic optical pellicle.

[c26] 26. The method of claim 25 further including the steps of:

planarizing said recessed portion on said first side of said pellicle plate to provide said monolithic optical pellicle with a first optically flat surface at said recessed portion; and

planarizing an opposing second side of said pellicle plate to provide said monolithic optical pellicle with a

second optically flat surface.

[c27] 27. The method of claim 18 further including the step of providing a plurality of openings traversing through said perimeter frame of said pellicle plate of said monolithic optical pellicle for introducing a gas flow over said recessed portion of said pellicle plate.

[c28] 28. The method of claim 27 further including the step of mounting said monolithic optical pellicle to a photomask by attaching said perimeter frame to said photomask, said mounted monolithic optical pellicle protecting said photomask during subsequent processing.

[c29] 29. The method of claim 28 further including the step of detaching said monolithic optical pellicle from said photomask for a rework process whereby damage to said monolithic optical pellicle is avoided as a result of said recessed portion being integrally formed with said perimeter frame.

[c30] 30. A method of protecting a photomask during photolithography comprising:
providing a photomask; and
attaching a monolithic optical pellicle to said photomask for protecting said photomask during subsequent photolithography processing.

